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MULTINATIONAL ACTIVITIES OF MAJOR U.S. AUTOMOTIVE PRODUCERS
Volume I -- Summary

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16. Abstract

The multinational activities of General Motors, Ford, Chrysler, and American Motors are documented and analyzed. The study consists of this and four other volumes. Volume II contains a compilation of data related to multinational operations; specifically it addresses research, development, engineering, production, marketing, and sales activities performed abroad. In Volume III, the research, development, and engineering activities abroad are analyzed. Volume IV provides a preliminary assessment of the technology transfers within each U.S. multinational producer. Volume V examines the diffusion of production and sales operations abroad; the timing and location of these investment are shown consistent with the Product Life Cycle Theory of International Trade and Investment.

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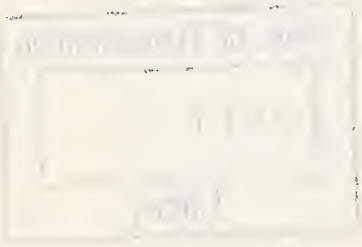


PREFACE

In the future, further reductions in fatalities, fuel consumption, and emissions due to automobile use will be needed. To insure that these goals are achieved, it is necessary to understand more thoroughly the process by which the development, implementation, and adoption of innovative automobile technology occurs. The current study, with its focus on the multinational activities of the major domestic auto manufacturers, provides an important link in addressing these questions. It examines the research, development, and engineering activities abroad, and the mechanism for technology transfers.

This work was initiated as part of the Auto Technology Program at the U.S. Department of Transportation, Transportation Systems Center, under the sponsorship of William Devereaux, Office of the Secretary of Transportation. During the conduct of this study, program responsibility was transferred to the National Highway Traffic Safety Administration. The work was completed with partial funding from the Implementation of Innovation by the Motor Vehicle Industry Program. The technical monitor for the study was Bruce Rubinger.

This work was carried out with financial support from the Auto Technology Program, Office of the Secretary, U.S. Department of Transportation.

Although the authors take sole responsibility for the information and analysis contained within this multi-volume report, they wish both to acknowledge and express their appreciation to William Devereaux of the U.S. Department of Transportation, who provided invaluable guidance in establishing the direction of the study. The advice and encouragement of the contract monitor, Bruce Rubinger of the Transportation Systems Center, are also acknowledged.

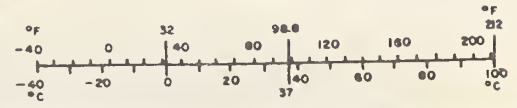
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



CONTENTS

1. DESCRIPTION AND MAJOR FINDINGS OF EACH VOLUME

The purpose of this summary is briefly to describe and assess the significance of the contents and principal findings of the four volumes on the multinational activities of the General Motors Corporation, Ford Motor Company, Chrysler Corporation, and American Motors Corporation. Each volume (II-V) has a more detailed summary of its contents and findings.

All four volumes emphasize the foreign passenger-vehicle operations (excluding Canada) of the four major U.S. producers.

The second volume provides considerable data, some not readily available and some published for the first time, on the multinational operations of these four U.S. producers. The third, fourth, and fifth volumes use the data (plus additional information, mainly from interviews with company managers) to analyze respectively:

1) research, development, and engineering activities abroad;
2) international patterns of technological innovation and transfer; and
3) production and sales operations abroad.

1.1 VOLUME II DATA ON THE FOREIGN FACILITIES AND OPEATIONS OF THE FOUR MAJOR U.S. AUTOMOTIVE PRODUCERS

The first part of Volume II provides data on the foreign operations of each U.S. producer. The second part presents data which are aggregated for three of the four U.S. producers: namely, General Motors, Ford, and Chrysler.

The individual data in Part One provides estimates of research, development, and engineering (RD&E) activities abroad. These estimates are cross-classified for a number of variables: location, type of RD&E, purpose, etc. Total and U.S. RD&E expenditures are also identified along with foreign RD&E outlays. One unique aspect of these estimates is that both broad and narrow definitions of RD&E are used to assess the extent of these activities in the United States and abroad.

Also, Part One provides considerable information on the location and magnitude of production and sales operations abroad in 1976. Organization charts are available which depict the principal subsidiaries for GM and Ford.

The data in Part One have been obtained from various public and private sources, including interviews with automotive managers familiar with their organizations multinational activities.

Part Two presents aggregate data derived from the Harvard Business School's data base on multinational enterprises. The data accessed for General Motors, Ford, and Chrysler encompass the entire hisotry of international operations for these three major U.S. producers. Again, data on the number of foreign subsidiaries are cross-classified by primary activity (sales or manufacturing) or national location against several other variables: e.g., ownership levels, employment levels; sales levels; asset levels; equity levels; and destination of sales or export levels.

1.2 VOLUME III EVALUATION OF RESEARCH, DEVELOPMENT, AND ENGINEERING PERFORMED ABROAD BY THE FOUR MAJOR U.S. AUTOMOTIVE PRODUCERS

Most of Volume III covers the RD&E activities abroad of only three producers; i.e., GM, Ford, and Chrysler, since AMC performs essentially no foreign RD&E.

This volume presents a number of findings about the current level (1976), growth, and composition of RD&E abroad; the location, primary purpose, and evolution of RD&E abroad; and the critical factors causing RD&E abroad.

Currently the U.S. producers are spending between 7 and 23 percent of total R&D outlays abroad depending on one's definition of research and development. The 7 percent share represents a narrow definition that excludes engineering and design work on existing models, while the 23 percent share includes them.

Nearly all of the RD&E performed abroad is either development or engineering work. RD&E expenditures abroad are skewed toward the near term compared with U.S. expenditures. However, RD&E performed abroad is similar to domestic RD&E since nearly all RD&E is in support of existing business activities defined as RD&E for conventional technology for traditional motor vehicles (internal combustion engines powered by gasoline).

The location of RD&E abroad favors a small but growing number of subsidiaries. Most of these subsidiaries and RD&E resources are located in Europe. However, some important RD&E activities are also located in selected subsidiaries outside Europe, notably Australia and Brazil.

In the past, RD&E work at these foreign subsidiaries has been geared primarily for product/process improvements for specific national markets. However, the last decade has witnessed a shift in RD&E responsibility from purely national to regional markets. If this trend continues, the future will see a concentration of RD&E resources at selected regional centers.

Most likely, the purpose of RD&E at these regional centers will continue to be the development of new and improved products or processes expressly for national markets within their economic regions. The possibility for transfer of these products and processes between regions will occur, when expedient, in terms of likely market success for products and significant cost reduction for processes.

However, the possibility does exist that a fundamental shift in RD&E purpose can occur in the near future. This shift will result in the performance of "multinational RD&E" to develop new products and processes expressly for near-simultaneous production in all major world markets. For example, Ford's Fiesta may be an early forerunner of multi-national RD&E.

1.3 VOLUME IV PRELIMINARY EVALUATION OF THE MULTINATIONAL ASPECTS OF TECHNOLOGICAL INNOVATION AND TRANSFER BY THE FOUR MAJOR U.S. AUTOMOTIVE PRODUCERS

The study makes a preliminary assessment of technology transfers which originate within each U.S. multinational producer.

These internal transfers of technology tend to be informal, unplanned, fuel-economy-related in terms of transfers to the United States, and most frequently between national subsidiaries participating in programs of complementation of production operations.

Further evidence is needed to substantiate these findings since potential repercussions, though speculative, have serious implications for the U.S. and world economies. Reinforced by findings in Volumes III and V, the repercussions we see include:

1) increased concentration of automotive resources through merger and consolidation;

2) increased multinationality of operations with greater complementation between subsidiaries within and across economic regions;

3) increased product standardization across national borders as vehicles get smaller and more fuel-efficient;

4) increased specialization of RD&E on a worldwide basis resulting in higher productivity of product/process innovation and greater potential transfers of technology; and

5) increased economic nationalism and protection aimed at controlling and eliminating deficits in automotive trade and technology transfer.

1.4 VOLUME V EVALUATION OF THE MULTINATIONAL DIFFUSION OF PRODUCTION AND SALES OPERATIONS BY THE THREE MAJOR U.S. AUTOMOTIVE PRODUCERS

Various findings about the motivation for investing in production and sales operations abroad, the timing and location of these investments, their concentration and size over time, and the market destination of sales over time support a dynamic interpretation of international trade and investment that predicts a diminishing role for the United States in the world automotive industry.

This theory, known as the Product Life Cycle Theory of International Trade and Investment, explains data from several sources spanning the entire history of investments made abroad by General Motors, Ford, and Chrysler. The implications are an increased probability for:

a) continual pressure on the U.S. trade position in motor vehicles, as shown in Exhibit 1, as long as the existing product cycle in motor vehicles is based on conventional technology (i.e., a new life cycle is not created);

b) continued deterioration of the U.S. share of world automotive production, as shown in Exhibit 2, as long as the existing product cycle is followed by U.S. producers; and

c) continual expansion abroad by the U.S. automotive multinationals in new markets in Latin America, Africa,

the Far East, and the Middle East as a principal source of growth that represents low risk and more certain returns over other investment alternatives.

2. EXHIBITS

Exhibit 1

U.S. Trade Balance in Motor Vehicles 1956-1976
(In Thousands of Units)

Year	Exports	Imports	Balance
1956	372	111	+ 261
1958	269	446	- 177
1960	322	468	- 146
1962	231	387	- 156
1964	317	553	- 236
1966	256	970	- 714
1968	428	1749	-1321
1969	437	2017	-1580
1970	379	2167	-1788
1971	486	2826	-2340
1972	531	2736	-2205
1973	661	2627	-1966
1974	815	2719	-1904
1975	864	2200	-1336
1976	881	2701	-1820

Note: Motor Vehicles include passenger cars, trucks, and bus chasses.

Sources: Trade Statistics for 1956 to 1971 of the U.S. Department of Commerce.
Statistics for 1972 to 1976 Motor Vehicles Manufacturers Association, World Motor Vehicle Data, 1977.

Exhibit 2

The U.S. Share of World
Production of Motor Vehicles (1900-1976)

(In Thousands of Units)

	United States	World	U.S. Percentage
1900	4	9	44.1
1905	25	63	39.8
1910	197	255	73.4
1915	970	1,015	95.6
1920	2,227	2,383	93.4
1925	4,266	4,901	87.0
1930	3,363	4,133	81.4
1935	3,971	5,134	77.3
1940	4,472	4,901	91.2
1945	725	1,124	64.5
1950	8,006	10,578	75.7
1955	9,204	13,743	67.0
1960	7,905	16,377	48.3
1965	11,138	24,542	45.4
1970	8,284	29,687	27.9
1972	11,311	35,796	31.6
1974	10,073	35,053	28.7
1976	11,497	38,533	29.8

Note: Motor Vehicles include passenger cars, trucks, and bus chasses.

Source: Statistics from Motor Vehicle Manufacturers Association, World Motor Vehicle Data, 1977.

3. SIGNIFICANCE OF STUDY'S FINDINGS

Our study focuses on the multinational activities of the U.S. automotive industry; yet its findings have relevance for domestic transportation as well as energy policy.

For just as domestic and international operations are unavoidably intertwined, so automobiles and energy are related inextricably . . . a relationship created by one simple word which represents a large share of our energy consumption. The word, of course, is gasoline.

The General Motors Corporation, Ford Motor Company, and Chrysler Corporation obviously account for mammoth shares of total international sales and total research, development, and engineering (RD&E) activities within the U.S. automotive industry. Yet, they also account for relatively large shares of international sales and RD&E activities for all U.S. businesses. For example, we estimate that these three multinationals spent nearly 2.5-billion dollars on RD&E, or about 16 percent of total industrial RD&E in 1976. During the same year, they also realized over 22-billion dollars in sales from foreign operations, or roughly 15 percent of the sales earned abroad by the top 50 U.S. multinationals.

Consequently, the foreign activities of GM, Ford, and Chrysler, and their RD&E investments, have tremendous importance for the U.S. public. It is no exaggeration to say that the way U.S. automotive multinationals allocate their worldwide resources

for research, development, engineering, production, and sales will affect the daily lives of all people in this country and the lives of many other people throughout the world.

Taken as a whole, Volumes II through V provide considerable information, numerous observations, and several findings about the multinational (including RD&E) activities of General Motors, Ford, Chrysler, and American Motors Corporation. However, the very extent of this information provides the possibility for losing sight of what all of the information implies.

Simply stated, the data in these Volumes imply two basic kinds of choices confronting the U.S. automotive multinationals, as well as the industry's probable answers to these two choices.

The first choice is between new technology involving substitutes for the internal combustion engine and gasoline versus advances in conventional engine and fuel technologies.

The second choice is related to the first: it is between allocating scarce resources to develop what will constitute a new automotive industry based on new or vastly different technology versus further expansion abroad with conventional technology.

The data, evaluations, and findings of these Volumes suggest that the U.S. industry's final choice will be for modified conventional technology and continued foreign expansion versus the development of new products and processes that represent a new industry or a fundamentally different automotive industry.

Interestingly, the U.S. government's current policies regarding fuel economy, emission standards, and safety encourage these selections. A large percent of the RD&E outlays of GM, Ford, and Chrysler are allocated to meet Government requirements which will result in improvements in existing technology. These incremental advances will have short-term benefits, yet little guarantee exists that existing Government regulations will solve the long-term and strategic needs of drastically reduced energy consumption, the development of new automotive engine and fuel technologies, and the re-emergence of the U.S. industry as a net exporter with a dominant share of world production.

On the positive side, Government regulations and actions taken independently by industry leaders have quickened the pace of socially beneficial innovation over the last decade. Whether this pace can be maintained or accelerated is a considerable challenge for the future. The challenge exists because many of the innovative gains achieved since the imposition of Government regulations have been based on established technology, especially in the area of fuel economy. For example, the "downsizing" of passenger vehicles has utilized technology, some of it transferred from abroad, that has existed in one form or another for several years. However, future advances will depend more on the creation of new technology, especially in materials and fuels. This new technology will require significant new capital investment not only in RD&E projects but also in tooling and production facilities. In short, the risks and uncertainties of future automotive innovation are likely to increase. Will the major U.S. automotive producers be able to assume these risks and uncertainties alone? Will the necessary supply of innovative

resources exist? Will existing resources be allocated by the U.S. multinationals to develop a new automotive industry without Government assistance? The evidence available to us today suggests a negative response to all three questions. The U.S. automotive multinationals are moving in defined directions regarding innovation and international expansion.

The major implication of our study is that in terms of the U.S. economy, these directions of innovation and international expansion must be changed.

Regarding the direction of innovation, our study shows substantial RD&E (23 percent of total RD&E) is performed abroad. As manufacturing resources are concentrated and expanded abroad (Volume V), the likelihood is that even greater amounts of RD&E will be performed abroad to compete in local markets. The direction for innovation abroad, consequently, will be the same as it is today: to modify and improve existing products and process technology. Unless the transition into "multinational RD&E" is made, very little technology produced from these RD&E efforts abroad will be transferred back to the United States (see Volumes III and IV).

The net result is that the U.S. producers will remain net exporters of U.S. technology. This RD&E and innovation strategy of incremental advance off traditional technology will probably make the U.S. multinationals (mainly, Ford and GM) more competitive in particular foreign markets, but will not necessarily help the U.S. economy.

Regarding the direction of international expansion, the study (Volume V) shows that the U.S. industry has followed consistently a model of international trade and investment that predicts an ever-diminishing competitive position for the domestic operations

of the U.S. multinationals. Again, the U.S. multinationals (mainly, Ford and GM) may be better off on a worldwide basis following this pattern of international expansion of manufacturing and marketing activities. Yet such expansion will likely continue to have adverse effects for the economy of the United States in terms of our trade balance, our share of world production, and our international balance of technology transfers.

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